TEXT DOCUMENT: MINNESOTA

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

A. **General and Supporting Information**

1. **State:** Minnesota

2. **Date of Filing:** May 26, 1998

3. **Contact Person & Telephone Number:** Dr. Kevin O'Grady; 612-282-2151; kevin@pucgate.puc.state.mn.us

4. **Hardware Requirements (i.e., disk space, memory requirements, etc.)**

133 MHZ or faster Pentium processor (200 MHZ preferred)1*
64 Megabytes of RAM*
400 Megabytes of hard drive capacity

5. **Software Requirements (i.e., operating system and version, spreadsheet software and version, etc.)**

Microsoft Window NT or Window 95 operating system
Microsoft Office Professional 97, with Microsoft Service Release 1 (SR-1) installed

6. **General Description of Study (identify whether study is based on the Benchmark Cost Proxy Model (BCPM) or HAI Model (identify version), a study or model prepared by a local exchange carrier (LEC), a state study or model for pricing unbundled network elements, or other source)**

The HAI Model, Version 5.0a

7. **Supporting Information**

(a) Please provide supporting information that includes a detailed description of the proposed cost study and all underlying data, formula, computations, and software associated with the study. The documentation should include a complete listing of algorithms and formulas used in the study and in any pre-processing modules. The supporting information should begin with an overview of the basic approach taken in the cost study, including the study's general methodology and basic assumptions. (Note: If the state cost study is a version of a cost model that is already being considered by the Commission as the basis for determining federal high cost support, it is not necessary to provide all underlying documentation; if the proposal contains changes to the algorithms or inputs of a model under consideration by the Commission, however, such changes must be clearly documented.)

RESPONSE:

A complete description of the process used by the HAI Model, version 5.0a (HM5.0a), including calculations and algorithms, is provided as part of model and accompanying documentation which

has already been provided to the Commission. The methodology used by HM5.0a is described in detail in HM5.0a Model Description. Appendices to the HM5.0a documentation describe the data tables present in HM5.0a and describe and explain the input fields. Minnesota-specific changes to HM5.0a that have been mandated by this Commission are as follows:

a Set cost of capital at 11.25% to meet FCC requirements

b. Set depreciation parameters at midpoints of FCC ranges for projection lives and net salvage percentages to meet FCC requirements.

c. Use the HM default regional labor adjustment factor for Minnesota (.99).

d. Use the following drop lengths:

Density Group(lines/sq. mi.)	Length(in feet)
0-5	422
5-100	450
100-200	220
200-600	168
600-800	136
800-2550	107
2550-5000	83
5000-10,000	75
10,000+	68

e. Use the following distribution structure mix parameters:

Density	Aerial %	Buried %	Underground %
0-5	18.0	78.0	4.0
6-100	14.0	80.0	6.0
101-200	9.0	81.0	10.0
201-650	5.0	84.0	11..0
651-850	3.0	85.0	12.0
851-2550	2.0	85.0	13.0
2551-5000	1.0	85.0	14.0
5001-10,000	1.0	84.0	15.0
10,000+	0.0	84.0	16.0

f. Use structure sharing parameter of 66%

g. Set the fraction available for shifting away from the preassigned structure mix equal to zero.

h. Use the following buried placement cost parameters:

Density Group	Recommendation
0-5	1.62
6-100	1.80
101-200	3.12
201-600	3/84
601-800	5.22
801-2550	5.90
2551-5000	6.49
5001-10,000	9.47
10,000+	10.41

i. Use 14.1% for overhead expense factor.

j. Increase the expense inputs affected by the "Network Operations Reduction" to reflect a change in the factor from 50% to 25%.

k. Spread network operations, other taxes and variable overhead expense items related to general loop support on a per line basis.

l. Assign all other general support expenditures related to the loop on a per line basis.

Processing Changes (see Appendix A):

m. Run with current actual line counts by wire center for all companies.

n. Remove 32 sold exchanges from US WEST inputs database.

o. Consolidate GTE territories in inputs database.

Model Changes (see Appendix A):

p. Modify model to count special access lines on a pair-equivalent basis in the distribution plant and on a circuit-equivalent basis in the feeder plant.

q. Modify model to include costs of dedicated idle lines.

(b) Please identify the sources of all underlying data used in the study and state whether these sources are included with this filing. If not, explain why not.

RESPONSE:

The sources for all inputs used in HM5.0a are provided in the HM5.0a Inputs Portfolio (HM5.0a HIP) which accompanies the Model. The HM5.0a HIP has also already been provided to the Commission. Sources for Minnesota-specific changes to HM5.0a that have been mandated by this Commission are as follows:

a. **Cost of capital -- Source: FCC**

b. **Depreciation parameters -- Source: FCC**

c. **Drop lengths -- Source: Testimony of US WEST witness William L. Fitzsimmons, *In the Matter of the State of Minnesota's Possible Election to Conduct Its Own Forward-Looking Economic Cost Study to Determine the Appropriate Level of Universal Service Support*, MPUC Docket No. P-999/M-97-909 ("MN Universal Service Proceeding")**

d. **Distribution structure mix percentages -- Source: Testimony of Minnesota Department of Public Service ("DPS") witness Wes Legursky, MN Universal Service Proceeding.**

e. **Structure sharing percentages -- Source: Testimony of DPS witness Wes Legursky, MN Universal Service Proceeding.**

f. **Disable structure shift function -- Source: Testimony of DPS witness Wes Legursky, MN Universal Service Proceeding.**

g. **Buried placement costs -- Source: Testimony of DPS witness Wes Legursky, MN Universal Service Cost Proceeding.**

h. **Overhead expense factor -- Service: Testimony of US WEST witness William L. Fitzsimmons, MN Universal Service Cost Proceeding.**

i. **Network operations reduction -- Source: Testimony of US WEST witness William L. Fitzsimmons, testimony of MCI/AT&T witness Dr. Robert Mercer, MN Universal Service Cost Proceeding.**

j. **Allocation of network operations expenses -- Source: Testimony of DPS witness Dr. Edward Fagerlund, MN Universal Service Cost Proceeding.**

k. **Allocation of general support expenses -- Source: Testimony of DPS witness Dr. Edward Fagerlund.**

l. **Treatment of special access lines -- Source: Testimony of DPS witness Wes Legursky, MN Universal Service Proceeding.**

m. **Treatment of dedicated idle lines -- Source: Testimony of DPS witness Wes Legursky, MN Universal Service Proceeding.**

B. Demonstration That the Cost Study Fulfills the Order's Criteria for State Cost Studies

Criterion 1: ***The technology assumed in the cost study must be the least-cost, most efficient, and reasonable technology for providing the supported services that is currently being deployed. A model, however, must include the incumbent LECs' wire centers as the center of the loop network and the outside plant should terminate at incumbent LECs' current wire centers. The loop design incorporated into a forward-looking economic cost study or model should not impede the provision of advanced services. For example, load coils should not be used because they impede the provision of advanced services. Wire center line counts should equal***

actual incumbent LEC wire center line counts, and the study's or model's average loop length should reflect the incumbent carrier's actual average loop length.

(a) Describe the network technology for which costs are computed, including switch types used, feeder and distribution technology, digital loop carrier devices, and other electronics, if any; type of interoffice technology; and any assumptions, such as maximum copper loop lengths or copper resistance constraints.

RESPONSE:

The network technology for which costs are computed is thoroughly explained in the HAI Model 5.0a documentation previously provided to the Commission. Nonetheless, a brief summary of the network technology costs are provided here for the Commission's convenience.

HM5.0a uses least-cost, most efficient technology that is currently being deployed by incumbent local exchange carriers (ILECs). Such technology includes next generation digital loop carrier systems, digital switching, fiber rings for interoffice transport, and signaling system 7 for the signaling network.

The maximum total copper cable length that is allowed to carry voiceband analog signals is 18,000 feet. When the potential copper cable length exceeds the threshold, it triggers long loop treatment and/or the deeper penetration of fiber based Digital Loop Carrier (DLC). Loops are designed to guarantee that loop transmission loss is statistically distributed and that no single loop in the distribution network exceeds the signaling range of the central office. Based on the most common current design plans applied on a forward-looking basis it is recommended, using Revised Resistance Design guidelines, that loops 18,000 feet in length should be non-loaded and have loop resistance of 1300 Ohms or less. The default value of 18,000 feet was chosen to be consistent with the minimum distance at which long loop treatment is usually required. (See section 2.7.6, HM 5.0a HIP)

HM5.0a treats subscribers served by cable lengths that exceed 18,000 ft (i.e., "long loops"), by locating small "subsidiary remote terminals" along the road cable to restrict the analog transmission distance over copper pairs to 18,000 ft. The road cables contain copper pairs and support T1 signals used to provide digital connections between the DLC remote terminals located in the centers of the subclusters and the subsidiary remote terminals. The model assumes conventional T1 transmission with 6,000 ft repeater spacing.

A road cable, depending on its length, may require several remote terminals. If, for example, the cable is 24,000 ft long, the model will serve the subscribers located along the first 18,000 ft of cable directly from the SAI and will place a small remote terminal at 18,000 ft to serve the remaining subscribers. If the cable length is, say, 42,000 ft, the model will again serve those subscribers along the first 18,000 ft directly and locate a small remote terminal at 36,000 feet. This remote terminal then serves the subscribers lying between 18,000 ft and 42,000 feet over copper pairs in the road cable; the remote terminal serves those subscribers lying between 18,000 and 36,000 ft by "back-feeding" over pairs in the same cable containing the T1 pairs. In all cases, the model equips sufficient repeaters at 6,000 ft intervals beginning at a point 3,000 ft from the remote terminal located in the center of the subcluster from which the road cables emanate.

(b) Explain how this technology is the least-cost, most-efficient, and reasonable technology currently being deployed for providing the supported services that are reflected in your study. Are technology determinations based on engineering practice rules of thumb or explicit optimization processes? If relying on engineering practices, provide any studies that show that these practices result in a least cost network. Describe any optimization routines or engineering rules of thumb that are used in the study to achieve a least-cost, most-efficient, and reasonable network design. In your response, please answer the following questions:

RESPONSE:

In addition to the response provided in part (a) above, the model developers have considered all technologies that are known to be deployable and for which costs can be established, and have selected what the industry considers to be the appropriate forward-looking technology. Where forward-looking practices embrace more than one technology, the selection of which depends on the particular demographics and/or topography of a particular area, the model includes an optimization routine to select between them. This includes, for instance, the selection of copper or fiber feeder (Section 6.3.5 of HM5.0a Model Description and Section 3.5.10 of HM5.0a HIP), wireline or wireless distribution (Section 6.3.4 of the HM5.0a Model Description and Section 2.11 of the HM5.0a HIP), type of structure -- aerial, buried, or underground (Section 6.2.5 of the HM5.0a Model Description and Sections 2.5, 3.1 and 3.2 of the HM5.0a HIP), and choice of interoffice rings versus redundant point-point links (Section 6.5.3.2 of the HM5.0a Model Description).

(1) Describe how the study determines whether feeder, subfeeder, and distribution plant should consist of fiber or copper, and whether electronics, such a T1 carrier system, are used in the feeder and subfeeder plant. Also, please describe the gauge(s) of copper considered in the study.

RESPONSE:

Copper/Fiber Crossover **(Section 6.3.5 of the HM5.0a Model Description)**

The decision whether to use fiber feeder is based on whether any of the following conditions are met:

a. The total feeder and subfeeder distance from the wire center to the main cluster centroid is greater than the user-adjustable Copper Feeder Max Distance value, whose default is 9,000 ft.

b. A life-cycle cost analysis of fiber versus copper feeder on the route shows that fiber is more economical.

c. The longest distribution cable run from the wire center to the farthest corner of a main cluster is greater than a user-input maximum analog copper distance, whose default value is 18,000 ft.

d. There is at least one outlier cluster subtending the main cluster.

Although the HAI 5.0a Model also includes a user adjustable "wireless investment cap" that may impact the use of fiber feeder, the Minnesota Public Utilities Commission has recommended that this function be disabled.

Use of T-1 Carrier (See sections 6.3.1. and 6.3.2 of HM5.0a Model Description, see also Section 2.8.8 of the HM5.0a HIP for discussion of T-1 repeater spacing parameters)

The basic distribution configuration employed by HM 5.0a for main clusters of customer locations is a "grid" topology, in which tapering backbone cables run north and south from the SAI(s), while branch cables extend east and west from the backbone cables past the individual subscriber locations. Outlier clusters, each consisting of one or more customer locations, are served by the nearest main cluster. A main cluster and its subtending outlier clusters together constitute a serving area.

Outliers are connected to the main cluster by copper road cables extending from the centroid of the main cluster to the centroid of the outlier. A given outlier may be directly connected to the main cluster, in which case it is labeled a "first order" outlier, or it may be connected to another outlier which in turn is connected directly to the main cluster or another outlier. Outliers that are not directly connected to the main cluster are considered to be "higher order" outliers.

If the right-angle route distance from the main cluster to the farthest customer location in a first order outlier is less than the user-adjustable distance parameter whose default value is 18,000 feet, the road cable carries an ordinary analog voice signal, and is called "subscriber road cable." If the farthest customer in an outlier is more than the default distance from the main cluster, or the outlier is a higher order outlier, the cable carries a digital T1 format signal to a remote T1 terminal at the centroid of the outlier, and is served by "T1 road cable." From the T1 RT, copper cables carrying analog signals extend the remainder of the way to the customer locations within the outlier.

A T1 road cable contains copper pairs, and supports T1 signals used to provide digital connections between the fiber DLC remote terminals located at the centroid of the main cluster and subsidiary remote T1 terminals located at the centroid of each outlier cluster. HM5.0a assumes conventional T1 transmission with a user-adjustable 32 dB repeater spacing. The cables serving subscribers from the remote terminals are assumed to be different than those that carry the T1 signals to the remote terminals. The total investment calculated for the T1 system includes the cost of the T1 interfaces in the main cluster's DLC remote terminal.

Cable Gauges (See sections 3.3.2 and 3.4.1 of HM5.0a HIP)

24-gauge copper feeder cable for cable sizes below 400 pairs, and 26-gauge copper feeder cable for cable sizes of 400 pairs and larger. Although 24-gauge copper is not required for transmission requirements within 18,000 feet of a digital central office with a 1,500 ohm limit, or a GR-303 integrated digital loop carrier system with a 1,500 ohm limit, a heavier gauge of copper is used in smaller cable sizes to prevent damage from craft handling wires in pedestals where wires may be exposed, rather than sealed in splice cases. For cables of 400 pairs and larger, splices are normally enclosed in splice cases, and are not subject to wire handling problems.

(2) Describe how the model determines the feeder and subfeeder paths that connect distribution areas to the wire center. Does the model rely on current feeder paths or does the model choose a different path? If the study or model determines feeder paths, describe the algorithm that determines the feeder path. Similarly, a model will connect customer locations within a distribution area to the serving area interface. Does the model employ an optimization routine or employ a rule of thumb for determining distribution routes?

RESPONSE:

See Section 6.4.2.1 and Figures 7 and 8 in Section 6.4.2.1, of the HM5.0a Model Description for a thorough discussion of these issues. However, for the Commission's convenience, below is a brief discussion of the information contained in the Model documentation.

The feeder plant layout is modeled independently of the existing feeder routes employed by the ILEC in question, according to the following algorithm. Main feeder routes extend from the wire center in as many as four directions.2 Subfeeder cables branch from the main feeder at right angles, giving rise to the familiar tree topology of feeder routes. The points at which subfeeders branch off the main feeder delineate main feeder segments, which are the portions of main feeder cable between two branch points.3

The centers (centroids) of the main clusters may fall in any of the four feeder route quadrants. A set of parameters, including the quadrant, airline (radial) distance and angles (omega and alpha), locate the main cluster with respect to the serving wire center. With this information, HM 5.0a applies straightforward trigonometric calculations to compute main feeder and subfeeder distances.4 The model computes sufficient subfeeder cable to connect the main feeder route to the centroid of each main cluster. Copper feeder cable always terminates at an SAI at the centroid of the main cluster. If the model calls for fiber feeder, the subfeeder terminates at an RT at the centroid, adjacent to an SAI.

Multiple serving areas share capacity on certain segments of the main feeder route. Segments located closer to the wire center require more capacity than segments near the periphery. HM 5.0a addresses this need by tapering the main feeder facilities as the distance from the wire center increases. Thus, it must determine the various "segment distances" so it can size the cable in each segment. The segment distances along a main route are calculated in two steps. First, the main clusters are sorted so they appear in the order of increasing distance along the main route. Segment distances are then calculated as the difference between the main feeder distances of adjacent main clusters.

The Distribution Module models distribution plant using a rule-of-thumb approach that is, however, consistent with the way ILECs would deploy distribution plant for the areas in question. The Model developers believe this to be a reasonably optimum way to lay out distribution plant.

(3) Describe how the study determines whether cable should be placed as either aerial, underground (conduit), or buried. Please identify whether the study assumes that plant mix decisions will be affected by zoning restrictions and, if so, how.

RESPONSE:

<u>Distribution and Feeder Structure Fractions</u>

See sections 2.5.1 and 3.2.1 for HM5.0a structure fraction assumed default for a thorough discussion of this topic. For the Commission's convenience a brief summary follows.

<u>Definition</u>:

The relative amounts of different structure types supporting distribution and feeder cable in each density zone. For distribution cable, in the highest two density zones, aerial structure includes riser and block cable.

Based on the fact that increasing density drives more placement in developed areas, and that as developed areas become more dense, placements will more likely occur under pavement conditions, it is assumed in HM5.0a that density, measured in Access Lines per Square Mile, is a good determinant of structure type.

Aerial/Block Cable:

The most common cable structure is still the pole line. Where an existing pole line is available, cable is normally placed on the existing poles. Abandoning an existing pole line in favor of buried plant is not usually done.

HM 5.0a accounts for drop wire separately; drop wire is not considered part of aerial cable in HM 5.0a. However, cable attached to the [out]sides of buildings, normally found in higher density areas, and referred to as "block cable," is appropriately classified to the aerial cable account. To facilitate modeling, HM 5.0a also reasonably includes Intrabuilding Network Cable under its treatment of aerial cable. Thus the default percentages (section 2.5.1, HM5.0a HIP) above 2,550 lines per square mile indicate a growing amount of block and intrabuilding cable, rather than cable placed on pole lines.

Buried Cable:

HM 5.0a assumes an increasing trend toward use of buried cable in new subdivisions. Since 1980, new subdivisions have usually been served with buried cable for several reasons. First, before 1980, cables filled with water blocking compounds had not been perfected. Thus, prior to that time, buried cable was relatively expensive and unreliable. Second, reliable splice closures of the type required for buried facilities were not the norm. And third, as reflected by zoning ordinances and subdivision covenants, the public now clearly desires more out-of-sight plant for both aesthetic and safety-related reasons.

Underground Cable:

Underground cable, conduit, and manholes are primarily used for feeder and interoffice transport cables, not for distribution cable. Distribution plant in congested, extensively paved, high density areas usually runs only a short distance underground from the SAI to the block terminal, thus it requires no intermediate splicing chambers. In higher density residential areas, distribution cables are frequently run from pole lines, under a street, and back up onto a pole line, or from buried plant, under a street, and back to a buried cable run. Such conduit runs are short enough to not require a splicing chamber or manhole and are therefore classified to the aerial or buried cable account, respectively.

In a "campus environment," where underground structure is used, it is owned and operated by the owner of the campus and not the ILEC. The cable is treated as Intrabuilding Network Cable between buildings on one customer's premises, and the cost of such cable is not included in the model.

Buried Fraction Available for Shift:

The Minnesota Public Utilities Commission has recommended that the structure shift function, as described below, be disabled.

(See Section 6.2.5 of the HM5.0a Model Description and Section 2.5.2 of HM5.0a HIP) HM5.0a permits a user-specified percentage of plant structure to be optimized between aerial and buried, while still permitting zoning requirements to be taken into account by limiting the amount of plant that will be subject to the optimization procedure. The Model does that by shifting a greater percentage of structure to aerial from buried if the model finds abnormal local terrain conditions make such a shift advantageous (a check in the model prevents percent aerial from going below zero). For example, if the user has entered an initial value of 0.40 for the buried cable fraction in a given density zone and then enters 0.75 as the buried fraction available for shift, the model can allow the computed buried fraction (according to changes in the relative costs of buried versus aerial structure occasioned by local surface and bedrock conditions) to vary between 0.10 (= 0.40 - 75% of 0.40) and 0.70 (= 0.40 + 75% of 0.40) – subject to the implied aerial fraction remaining non-negative.

(4) Does the study incorporate wireless technology? If so, please describe how.

RESPONSE:

See Section 6.3.4 of the HM5.0a Model Description and Section and Section 2.11 of the HM5.0a HIP for a thorough discussion of this issue. For the Commission's convenience, however, below is a brief summary of that information.

As requested in the FCC's FNPRM, HM 5.0a permits the specification of a user-adjustable cap on the model's relevant wireline investments to reflect potentially more economical wireless distribution technologies. In HM 5.0a this cap, if invoked by the user, is implemented by placing a ceiling on the per-line investments computed in the Distribution module (i.e., NID, drop, terminal and splice, distribution cable and structure, SAI, and DLC RT) that would be replaced by the wireless system.

The optional cap calculation considers the cost of two different wireless systems: a "point-point" system serving customers on a one-one basis, and a "broadcast" system serving a number of customers from a shared base station. The point-point cost is assumed to be a fixed amount per line served; the broadcast system cost is structured as a fixed base station cost serving up to a given maximum number of customers, with the cost of the base station distributed among the number of customers that use it, plus a per-line cost of the radio terminal equipment at each customer's premises. The Model compares the cost of the two wireless systems to each other for a given serving area, then compares the cost of the lower-cost system to the wireline cost. If the most economical wireless system's cost is lower, the Model zeroes out the cost of the wireline distribution components for that serving area, and substitutes the cost of the wireless distribution system, while retaining the feeder portion of the wireline network.

The Minnesota Public Utilities Commission determined that there is presently insufficient evidence to support enabling the "wireless cap" function of the HA1 5.0a Model.

(5) Does the study incorporate host-remote switching configurations? If so, how? In your

explanation, please discuss how host locations are identified and how costs are allocated among customers in wire centers that are part of host-remote relationships.

RESPONSE:

HM 5.0a is capable of engineering and costing end office switching systems comprised of explicit combinations of host, remote and standalone switches. But, because accurate data on the purchase prices of a portfolio of host, remote and standalone switches of varying capacities may not be available to the user, the HM 5.0a Switching and Interoffice Module defaults to computing end office switching investments using input values that average per-line investments over an efficient portfolio of host, remote, and standalone end office switches.

If the user selects the host, remote, standalone option, the user must specify for each wire center whether the housed switches are hosts or remotes, as well as assign correspondences between hosts and remotes. The model will designate all remaining wire centers as housing standalone switches. The model then places the hosts and their subtending remotes on host/remote SONET rings.

The model sizes the host-remote rings to accommodate host-remote umbilical trunk and control link requirements. It then computes investment in SONET add/drop multiplexers ("ADMs") and digital cross connects ("DCSs") for the host/remote ring and calculates the average ADM and DCS investment per line for all lines in the system. The host interoffice calculations also are adjusted to account for the increased trunk and signaling capacity requirements imposed by the remotes served by the host.

When the host-remote option is selected, switching curves that correspond to host, remote and standalone switches are used to determine the appropriate switching investment. These switching curves incorporate a fixed plus variable investment per line for each switch type. It is recognized that there are large and small host and standalone switch technologies, and that remotes are available in multiple line sizes. Remote switches cause incremental variable investments primarily associated with the umbilical trunk ports necessary to carry traffic originating and terminating on the remote lines to the host switch. The user adjustable fixed and variable investments for host, standalone and remote switches have been scaled accordingly. In accordance with the FCC's Public Notice guidelines, the cost of an entire switching system consisting of a host and its associated remotes, is allocated evenly over all lines served by the host-remote configuration.

(c) Describe how the study incorporates assumptions that the incumbent LECs' wire centers are the center of the loop network and that the outside plant terminates at the incumbent LECs' current wire centers.

RESPONSE:

See Section 5.2 of the HM5.0a Model Description for a thorough discussion of this issue. For the Commission's convenience, however, below is a brief summary of that information.

The source of the information used to locate wire centers in HM5.0a is Bellcore's LERG database, dated August 1, 1997.5 The portions of these LERG data that are used in the HAI model are an extract of key data from the LERG called the Special LERG Extract Data ("SLED") – which has been licensed from Bellcore by the HAI model developers. The SLED specifies the precise location of each ILEC wire center. The demographic data prepared by PNR for input to the model

identifies, for each cluster identified by the customer location and clustering process, the wire center that serves that cluster, the precise location of the cluster relative to the wire center, and all other relevant information pertaining to the cluster, such as the terrain characteristics, number of households, and number of lines. The model then determines feeder cable types, capacities, and routes that emanate from the wire center and terminate in the clusters served by the wire center. In this fashion, the wire center appropriately becomes the center of the loop network, and forms one termination of all feeder cables serving clusters belonging to that wire center.

(d) Describe how the loop design incorporated into the study does not impede the provision of advanced services while still meeting the criterion in (b), above.

RESPONSE:

As described in response to Criterion 1 (a) above, if the farthest customer in an outlier cluster is more than the default distance of 18,000 feet from the main cluster, the cable serving that customer, or customers carries a digital T1 format signal to a remote T1 terminal at the centroid of the outlier cluster, and is served by "T1 road cable." From the T1 RT, copper cables carrying analog signals extend the remainder of the way to the customer locations within the outlier.

The T1 road cable contains copper pairs, and supports T1 signals used to provide digital connections between the fiber DLC remote terminals located at the centroid of the main cluster and subsidiary remote T1 terminals located at the centroid of each outlier cluster. HM5.0a assumes conventional T1 transmission with a user-adjustable 32 dB repeater spacing. This ensures that all customers can receive digital services at an ISDN Basic Rate Interface or faster digital data rate.

(e) Describe how distances are measured in the model (e.g., does the model use airline distances, adjusted airline distances, rectilinear distances, or road distances)? Please identify in each portion of the model in which a particular distance metric is used and why that metric was selected.

RESPONSE:

See Section 6.2 of the HM5.0a Model Description for a thorough discussion of this issue. For the Commission's convenience, however, below is a brief summary of that information.

In most instances, the model uses "rectilinear" distances for routing between any two points, meaning that cables follow a right-angle route between their endpoints. In this way, the calculated distances take into account the deviation from straight lines that are caused by various natural and man-made obstacles. An exception to this general practice is that when the user invokes the "feeder steering" option (See Section 6.3.6 of the HM5.0a Model Description), in which the main feeder routes are directed optimally towards the clusters they serve, a user-specifiable route/air ratio additionally multiplies the calculated rectilinear route distance, in order to ensure that the steered feeder has not follow an unrealistically efficient route to its destination.

(f) Do wire center line counts equal actual incumbent LEC wire center line counts? If so, and if a closing factor is used to achieve this equality, describe the size of the closing factor and how it is used in the study. If the study's wire center line counts do not equal actual incumbent LEC wire center line counts, explain why not.

RESPONSE:

Line counts by type (i.e., residence, single line business, multiline business, public telephone and special access lines) are estimated at the wire center level by HM5.0a. Line counts are normalized to the total reported by the ILEC in 1996 ARMIS and 1996 NECA USF Loops filing. The Model can be normalized to the wire center level if comprehensive LEC data on line counts by individual wire center are available. When closing is done at the study area or overall ILEC level of detail, the closing factors are dependent on the state and company in question, but are most frequently in the range of 95-105%.

The Minnesota Public Utilities Commission has directed the use of actual line counts by wire center for each company, instead of line counts estimated by the Model.

(g) Does the study's average loop length reflect the incumbent LEC's actual average loop length? If not, explain why not.

RESPONSE:

The model produces the average loop length at the selected level of disaggregation (e.g., wire center) as an output. This output can be compared to the ILEC estimate if the latter is provided by the appropriate ILEC. The model does not automatically "reflect" an ILEC estimate.

(h) Please describe how the study determines customer location. Specify the data that were used to determine the number and location of customers. In addition, please describe in detail if the study locates customers in grids, clusters, census blocks, census block groups, or other areas smaller than a wire center. How does the study identify serving areas?

RESPONSE:

See Sections 5.4, 5.5 and 5.6 of the HM5.0a Model Description for a thorough discussion of this issue. For the Commission's convenience, however, below is a brief summary of that information.

<u>Residence Locations</u>

The customer location approach used in HM 5.0a is fundamentally different from any other that uses arbitrary geographic delineators such as CBs, CBGs or latitude and longitude grid cells. Because HM 5.0a's approach identifies the actual locations of most telephone customers, it produces the most sophisticated demographic data set of its type. The process first develops a database of about 109 million customer address records. These addresses are then geocoded (assigned latitude and longitude coordinates). These locations are then divided among wire center serving areas based on geocoded customer location and the Business Location Research (BLR) wire center boundaries.

Data for residence locations are provided by Metromail, Inc. The Metromail National Consumer Database© ("NCDB") is a large, nationally compiled file of U.S. household-level consumer information that includes both deliverable postal addresses (and telephone numbers, when available). The file consists of close to 100 million records – which constitute over 90% of all

residential housing locations that the U.S. Bureau of the Census reported for 1995.6

The file is compiled primarily from telephone white pages directory data, but also utilizes many other primary sources of information, such as household mover records, voter registration data, motor vehicle registration information, mail-order respondent records, realty data, and home sales and mortgage transaction information, to build a large repository of verified household-level data.

Business Locations:

Dun & Bradstreet (D&B) collects information on more than 11 million business establishments nationwide. Information is gathered from numerous sources such as business principals, public records, industry trade tapes, associations, directories, government records, news sources, trade organizations, and financial institutions. This information is validated each night. Additionally, D&B conducts millions of annual management interviews to help improve the timeliness and accuracy of its information.

This information is organized by D-U-N-S number, a nine digit identification sequence which allows for the placement of companies within larger business entities according to corporate structures and financial relationships. D&B also provides "demographic" information on each of the firms in its database. Such information includes counts of employees and the SIC code of the establishment.

Geocoding

Geocoding is used in order to most accurately assign known customer locations to actual, physical locations. Geocoding is also known as location coding. It involves the assignment of latitude and longitude coordinates to actual street addresses. Geocoding software is sophisticated enough to provide information regarding the source and precision of the lat/long coordinates selected. This precision indicator allows PNR and Associates of Jenkintown, PA (PNR), to select only those addresses that have been geocoded to a highly precise point location. Almost uniformly, geographical address locations are derived from enhanced versions of the USGS' TIGER database.

To perform its geocoding, PNR uses a program by Qualitative Marketing Software called Centrus Desktop. The enhanced data behind Centrus is provided by GDT. Premium GDT data are updated bi-monthly to ensure accuracy. These data integrate new information from US Postal Service ("USPS") databases and private sources so that new streets and additions and changes to ZIP codes, street names, and address ranges are included as soon as possible.

Centrus Desktop allows geocoding on two levels. The first is a match to the actual address -- which is the only type of geocoding used in HM 5.0a customer location. The second is a match to a ZIP code (ZIP, ZIP+4, ZIP+2) level. Because of the lesser accuracy in the second method, these geocodes are not used in PNR's process of assigning customer locations.

Data hierarchy in address geocoding starts with the State. The hierarchy continues with City, Street Name, Street Block, and finally, House Range. Typically, a Street Block is the same as an actual physical block but it can also represent a partial block as well. The House Range displays address information from the USPS. Additionally, where there are gaps in the actual address

range, the House range will account for these gaps.

Initially, the address coding module in Centrus Desktop compares the street addresses from the input file to the records contained in the USPS ZIP+4 directory and the enhanced street network files. If the address is located in the USPS files, the address is standardized and a ZIP+4 is also returned. If this address is also found in the street network files, Centrus Desktop determines a latitude and longitude for the location. Optionally, if the address is not found in the street network files, location information may be applied from the ZIP level.7 Location codes generated by Centrus Desktop indicate the accuracy of the geocode. For purposes of customer location clustering in the HM 5.0a only those geocodes assigned at the 6-decimal place point location made directly to the street segment are used.8

While the software and data used allow for a much more comprehensive output of data elements, for use in HM 5.0a customer location, the following addressing elements are extracted:

Address
City
State
ZIP
ZIP+4
Latitude
Longitude
Census Block
Match Code
Location Code

Gross-up

The above-derived precisely geocoded locations are then counted by CB. These geocoded location counts by CB are then compared to target total line counts for that CB derived by the PNR NALM (described in section 2.3 of the HM5.0a Model Description). If the geocoded location counts are less than the target count, the residual number of customer location points is then computed, and geographical locations for these points are generated. This process is performed by PNR using TIGER file CB boundaries. Each of the additional number of customer location points that a CB requires to total to its target count is generated and assigned a geocode so as to place these "surrogate" points uniformly along the CB's boundary. While these boundary-assumed locations for the gross-up or surrogate points are plausible – because most CBs are bounded by roads – this is also a conservative placement of the gross-up points because it assumes they are maximally separated from one another.

As a result of this gross up process, the customer location file now contains records for each of the U.S.'s more than 100 million customer locations with a geocode (either calculated precisely or through the gross up process) associated with it.

(i) How does the cost study determine the cost of the outside plant from the wire center to the customer locations identified in (g)? Does the cost study estimate the costs of a forward-looking network, or does the cost study rely on a loop length study? If the cost study relies on a loop length study, please describe how the cost study relies on the loop length study and provide the loop length study as part of the documentation provided in response to II.(7)(a), above, including a discussion of the sampling methods used in the loop length study. Also, if a loop length study is used to estimate forward-looking costs, please compare the mix of loop technologies in the loop length study sample to the mix of technologies in the loops assumed by the cost study. If the mix of loop technologies assumed in the cost study is based on the mix of technologies in the sample, please justify the use of this assumption.

RESPONSE:

HM5.0a estimates the costs of a forward-looking network. The components of the loop from the wire center to the customer location are depicted in Figure 1, Section 3.1 of the HM5.0a Model Description. The loop components depicted in Figure 1 are described in detail in Sections 3.1.1.1, 3.1.1.2 and 3.1.1.3 of the Model Description. The estimated forward-looking costs for outside plant components modeled in HM5.0a from the wire center to customer locations are explained and supported in Sections 2 and 3 of the HM5.0a HIP.

(j) If the cost study meets criterion 1 in any way not captured by (a) through (h), please explain.

The Model documentation and the above responses together fully describe how the HAI Model, Version 5.0a meets criterion 1.

Criterion 2: ***Any network function or element, such as loop, switching, transport, or signaling, necessary to produce supported services must have an associated cost.***

(a) Does the study contain costs associated with all network functions or elements (such as loop, switching, transport, or signaling) necessary to produce supported services?

RESPONSE:

The HM5.0a developers have systematically identified all elements necessary to provide universal service at a level of disaggregation sufficient to allow costs to be assigned to each element, and have modeled the cost of each of those elements.

(b) What nonsupported services, if any, are currently included in your cost study, and are the costs associated with provision of advanced services included in your calculation of cost?

RESPONSE:

Only the costs of supported services are included in the HAI Model, with one exception. It is that support of both basic and non-supported services that is typically bundled into a single software package by the current vendors of switching equipment; the code that specifically provides the supported service cannot be separately purchased. Nor do the manufacturers provide reliable data on the breakdown of costs between the two categories of services. Thus, the bundled switching costs used in the model may include non-supported services.

(c) If the cost study meets criterion 2 in any way not captured by (a) and (b), please explain.

The Model documentation and the above responses together fully describe how the HAI Model

meets criterion 2.

Criterion 3: ***Only long-run forward-looking economic cost may be included. The long-run period used must be a period long enough that all costs may be treated as variable and avoidable. The costs must not be the embedded cost of the facilities, functions, or elements. The study or model, however, must be based upon an examination of the current cost of purchasing facilities and equipment, such as switches and digital loop carriers (rather than list prices).***

Describe how the costs used in the study represent long-run, forward-looking costs. In particular, describe and verify how the costs of facilities and equipment used in the study reflect the current costs of purchasing those facilities and equipment.

RESPONSE:

HM5.0a is designed to accurately estimate the costs that an efficient carrier would incur to provide service in the geographic area being studied. The costs developed are not constrained by the embedded characteristics of the ILECs' networks or operations. The Model correctly applies a long run assumption by treating the ILECs' embedded cost structure, except for the location of wire centers, as variable and avoidable. The treatment of costs by HM5.0a is consistent with sound economic principles and the requirements set forth in this paragraph of the FCC Order.

The HAI Model documentation fully describes how the model meets criterion 3.

Criterion 4: ***The rate of return should be either the authorized federal rate of return on interstate services, currently 11.25 percent, or the state's prescribed rate of return for intrastate services.***

(a) What rate of return is used in the cost study?

RESPONSE:

See section 6.6.2 of HM5.0a Model Description, and Section 5.1 of the HM5.0a HIP for a thorough description of this issue.

HM5.0a allows the user to separately input cost of debt, cost of equity, and the percentage of debt directly through the graphical user interface. Either federal or state values can be used. As a default, the Model uses weighted average cost of capital (return) built up from several components. A 45/55 debt/equity ratio is assumed, with a cost of debt of 7.7 percent and a cost of equity of 11.9 percent, for an overall weighted average cost of capital of 10.01 percent (see part (b) below).

The Minnesota Public Utilities Commission has directed the use of a cost of capital of 11.25%, consistent with the currently authorized federal rate of return on interstate services.

(b) Please provide an explanation of the basis for the rate of return used if it is different from the authorized federal rate of return on interstate services. If available, please identify any documents (e.g., commission orders) supporting the value used in the study.

RESPONSE:

The Minnesota Public Utilities Commission has directed the use of a cost of capital of 11.25%, consistent with the currently authorized federal rate of return on interstate services.

(c) If the cost study meets criterion 4 in any way not captured by (a) and (b), please explain.

The Model documentation and the above responses together fully describe how the HAI Model meets this criterion.

Criterion 5: Economic lives and future net salvage percentages used in calculating depreciation expense should be within the FCC-authorized range and use currently authorized depreciation lives.

Please identify the depreciation rates and future net salvage percentages used in the cost study.

RESPONSE:

Depreciation lives and net salvage percentage inputs in HM5.0a are, like all inputs, user adjustable. Following are the depreciation lives and net salvage percentages set at the midpoints of the FCC ranges as required by the Minnesota Commission:

Plant Type	Economic Life	Net Salvage %
motor vehicles	8.50	15.00
garage work equipment	15.00	5.00
other work equipment	15.00	5.00
buildings	40.00	5.00
furniture	17.50	5.00
office support equipment	12.50	5.00
company comm. equipment	8.50	2.50
general purpose computers	7.00	2.50
digital electronic switching	17.00	2.50
operator systems	10.00	2.50
digital circuit equipment	12.00	2.50
public telephone term. equipment	8.50	5.00
poles	30.00	-62.50
aerial cable, metallic	23.00	-22.50
aerial cable, non metallic	27.50	-17.50
underground cable, metallic	27.50	-17.50
underground cable, non metallic	27.50	-12.50
buried cable, metallic	23.00	-5.00
buried cable, non metallic	27.50	-5.00
intrabuilding cable, metallic	22.50	-17.50
intrabuilding cable, non metallic	27.50	-7.50
conduit systems	55.00	-5.00

Criterion 6: ***The cost study or model must estimate the cost of providing service for all businesses and households within a geographic region. This includes the provision of multi-line business services, special access, private lines, and multiple residential lines. The inclusion of multi-line business services and multiple residential lines will permit the cost study or model to reflect the economies of scale associated with the provision of these services.***

Describe how the study takes into account the cost of providing service for all businesses and households within a geographic region, including the provision of multi-line business services, special access, private lines, and multiple residential lines per household.

RESPONSE:

The input demographic database includes the specification of the number of primary and secondary residential lines, single-line business lines, multiline business lines, special access lines, and public lines. It can add private lines and intraLATA dedicated circuits if such information is available from the ILECs. The Model builds a network sized to serve all these categories of lines. It then allows the user to select the categories of lines -- typically primary residential lines and single-line business lines -- for which USF subsidies are to be calculated. Therefore, as this criteria requires, the HAI Model takes into account the cost of providing all services, while only determining subsidies associated with lines that fall within the definition of universal service.

Criterion 7: ***A reasonable allocation of joint and common costs should be assigned to the cost of supported services.***

Describe how the study's methodology assigns a reasonable allocation of joint and common costs to the cost of supported services. What is the amount of common costs attributed to supported services, and what percentage does this represent of total common costs as identified in the study or model? Please explain how this amount was determined. Specifically, please identify how line-side port costs are identified as a portion of total switching costs.

RESPONSE:

See Section 6.6.3.2 of the HM5.0a Model Description and Appendix C of the HM5.0a HIP for a thorough discussion of this issue. For the Commission's convenience, however, below is a brief summary of that information.

The Minnesota Public Utilities Commission has directed the use of an overhead factor of 14.1%, based upon US WEST's overhead expenses using 1996 data.

To the extent that certain components of the network -- the loop and the part of the switch associated with the attachment of lines to the switch -- may be considered to be joint and common costs, the model allows the user to specify the portion of each that are attributed to universal service. The default values for these assignments are 100% in each case. The fraction of the total switching cost that is assumed to be not associated with the connection of lines to the switch is user-adjustable as well, with a default value of 70%.

Criterion 8: ***The cost study or model and all underlying data, formulae, computations, and software associated with the model should be available to all interested parties for review and comment. All underlying data should be verifiable, engineering assumptions reasonable, and outputs***

plausible.

(a) Please identify any underlying data, formulae, computations, or software used in the study that are not available for review and comment, and explain why they are unavailable.

RESPONSE:

All input data, formulae, computations, and software used by the model are available for review and comment. The complete HM5.0a software and associated databases have been provided to the Commission and Staff and filed with the FCC. In addition, accompanying the Model Software are the HM5.0a Model Description which describes the Model calculations and inputs in detail, as well as the HM5.0a HIP, which describes, explains and provides support for each input used in HM5.0a. The Automation Description and User Guide, which is included with the Model software, provides complete instructions for using HM5.0a.

(b) Please describe what steps were taken to determine that the study's outputs are plausible.

RESPONSE:

Demographic and terrain data input to the model have been developed using the services of competent firms whose business is to provide such databases. The algorithms and assumptions of the model have been developed by people with extensive experience in the design and deployment of local exchange telecommunications networks by ILECs and other parties. The algorithms and associated software have been subject to intense internal and external scrutiny to ensure its accuracy. Inputs to the model are based to the greatest possible extent on publicly-available relevant data, including the ARMIS data of the ILECs being studied. Again, those inputs have been subject to intense internal and external review and comment.

(c) Standardized presentation of outputs. If the state cost study is based on a version of the HAI model, please file: the universal service calculation, cost summary, cost of network elements, and USOA detail breakdown (HAI 5.0 only) reports. If the state cost study is based on a version of BCPM, please file: the area-wide summary, key elements, aggregate support summary and plant summary reports. If the state cost study is based on neither BCPM nor HAI, please provide outputs in either of the BCPM or HAI formats just mentioned, or provide investment and expenses per study area by USOA accounts or ARMIS rows, and show whether and how cost calculations differ across geographic areas.

RESPONSE:

An output summary is being provided along with this text document.

(d) If the cost study meets criterion 8 in any way not captured by (a) through (c), please explain.

The HAI Model documentation and the above responses together fully discuss how the Model meets this criterion.

Criterion 9: ***The cost study or model should include the capability to examine and modify the critical assumptions and engineering principles. These assumptions and principles include, but are not limited to, the cost of capital, depreciation rates, fill factors, input costs, overhead adjustments, retail costs, structure sharing percentages, fiber-copper cross-over points, and terrain factors.***

(a) Please describe the extent to which and how the user can examine and modify the cost study's critical assumptions and engineering principles.

RESPONSE:

HM5.0a is a completely open model. Each input can be reviewed and changed by the user. In addition, all of the Model's cells containing formulae are open and available for the user to make direct changes to both calculations and input. Finally, the HM5.0a Graphical User Interface makes it possible for the user to run and store up to 9,999 different scenarios in order to determine the impact of a wide range of input values.

(b) Standardized presentation of inputs. Please provide the input values used in your cost study using the attached Excel spreadsheet document. If your study uses input values that are not identified in the Excel document, please add them to the end of the list in the appropriate category. You may also provide the standard presentation of inputs in electronic form in an identical spreadsheet prepared using any other commercially-available spreadsheet software.

RESPONSE:

The required spreadsheet is being provided along with this text document.

(c) If the cost study meets criterion 9 in any way not captured by (a) and (b), please explain.

The Model documentation and the above responses together fully discuss how the Model satisfies this criterion.

Criterion 10: ***The cost study or model must deaverage support calculations to the wire center serving area level at least, and, if feasible, to even smaller areas such as a Census Block Group, Census Block, or grid cell in order to target universal service support efficiently.***

(a) Describe the manner in which the study disaggregates investment calculations to small geographic areas, such as wire centers, census block groups, census blocks, or grid cells and identify the level to which cost calculations are disaggregated. For example, please describe how costs that are shared among customers in different geographic areas, such as feeder structures, are allocated.

RESPONSE:

The HAI Model 5.0a can calculate and display cost calculations on a wire center, density zone, or census block group (CBG) basis, or individual customer cluster level of disaggregation. As a result, the Commission is free to determine state universal service funding requirements on a statewide basis, or can consider such funding requirements for distinct geographic areas in the state.

C. **Demonstration that the Cost Study Fulfills Other Requirements of the *Universal Service Order***

1. ***"In order for the Commission to accept a state cost study submitted to [the Commission] for the purposes of calculating federal universal service support, that study must be the same cost study that is used by the state to determine intrastate universal service support levels pursuant to section 254(f)."*** 9

If your state has an intrastate universal service support mechanism for non-rural LECs, please demonstrate that the cost study being submitted for the purpose of calculating federal universal service support is the same cost study that will be used by your state to determine intrastate universal service support levels pursuant to Section 254(f) of the Telecommunications Act of 1996.

RESPONSE:

At this time, Minnesota does not have an intrastate universal service support mechanism for non-rural LECs.

2. ***"We also encourage a state, to the extent possible and consistent with the above criteria, to use its ongoing proceedings to develop permanent unbundled network element prices as a basis for its universal service cost study."*** 10

Please explain the interrelationship, if any, between this universal service cost study and the cost study that will be used by your state in developing permanent prices for unbundled network elements.

RESPONSE:

A docket is currently open in which the MPUC will consider the appropriate cost model for unbundled network elements. The hearing was held in that docket April 20, 1998 through May 1, 1998. AT&T and MCI are advocating the use of the HAI Model, Version 5.0a in that cost dockets and a decision is pending.

Appendix A

(prepared by AT&T)

Minnesota Commission Ordered Results

	GTE/Contel	Frontier	Sprint	U S West
SA Channels	9,897	57,164	2,916	573,138
SA Pairs	5,651	3,913	1,881	170,738
Dedicated Idle	14,584	5,592	3,635	54,718
Residence Lines *(i)*	116,251	95,756	113,806	1,452,534
Total Lines (Channels)	141,909	180,223	153.419	2,708,099
Cost per Line per Month	**$68.26**	**$38.95**	**$39.15**	**$24.68**

(i) Residence Lines include dedicated idle

Creating the data set

(1) U S West sold exchanges must be removed from the data set. Adjustments are also necessary in the distance files. For simplicity I also removed all companies not being reviewed from the database.

(2) GTE and Contel were combined into one company.

(3) The Armis and distance files were adjusted as appropriate.

(4) Line count data supplied by the companies (Contel, Frontier, Sprint and U S West) were used to repopulate the database with wire center line count information.

(5) U S West line counts were taken out of the FCC line counts used by BCPM. Non-revenue loops were used for dedicated idle.

(6) U S West did not provide line counts for SABNMNSA. The defaults out of the HAI Model were used. For the pair equivalent data, for this wire center, the U S West ratio of SA Pairs to SA Channels was used to estimate the channel equivalent SA lines.

(7) I changed MPLSMN07 in HAI to MPLSMNAS.

(8) I used the line counts from GLVYMNOR out of BPCM for GLVYMNDO in HAI.

(9) For all databases I allocated dedicated idle lines.to residential lines.

Methodology

Special Access line counts as ordered by the Commission

The Commission ordered that special access lines be treated on a pair equivalent basis in the distribution module (as they are treated in BCPM) and on a channel equivalent basis in the Feeder module (as they are treated in HAI). The Commission also ordered the inclusion of dedicated circuits. The following describes the methodology used to incorporate these changes.[11]

(1) Two data sets need to be created. One that treats special access lines on a channel equivalent basis (DS-0 equivalent). The other treats special access lines as pair equivalent (sometimes called loop equivalent).

(2) Each data set was run through the model with the Minnesota specific inputs ordered by the Commission. The distribution investments for the pair equivalent output are used in place of the distribution investments from the channel equivalent output.[12] The result is the proper investment amounts. Total costs are generated by the expense module.

(3) Total expenses for distribution and feeder need to be divided by the appropriate number of lines. Dedicated idle needs to be removed from the denominator when calculating cost per line. When calculating NID and distribution cost per line the special access lines portion of the denominator needs to be reduced to account for pairs instead of channels.

Issues to Consider

(a) I distributed dedicated idle lines among density zone in proportion to the residential lines in that density zone. This is the easiest way to distribute these lines. Since dedicated idle lines are reported by wire center a more precise, but time consuming, method of distributing these lines would be to distribute them according to the residential lines occurrence within a density zone wire center by wire center.

	GTE/Contel	Frontier	Sprint	U S West
Dedicated Idle Average	14.3%	6.2%	3.3%	3.9%
Average Deviation *(i)*	5.2%	2.1%	1.5%	2.6%

(i) The average deviation is the average difference observations are from the mean.

To test whether the above assumption distorted results I used the GTE/Contel data, since GTE/Contel has the highest and most volatile dedicated idle average. I allocated these lines to density zone wire center by wire center. This had no effect on loop cost and a small effect on the density zone USF calculation (increased 0.29%).

(b) The two data sets have different density zone calculations, since there are a different number of total lines in each data set. This could have the effect of shifting pair equivalent special access lines into lower density zones than their channel equivalent counter parts.

I used the channel equivalent database as a basis since we are starting with the HAI Model which calculates density on a channel equivalent basis.

		Density Zone

	Total	0-5	5-100	100-200	200-650	650-850	850-2550	2550-5000	5000-10000	>10000
GTE/ Contel										
SA Chan	9897	565	2996	1910	2545	618	770	524	0	0
SA Pair	5651	437	1863	727	1535	469	322	298	0	0
Pair / Chan	57%	77%	62%	38%	60%	76%	42%	57%		
Frontier *(i)*										
SA Chan	57164	207	4338	3876	18965	1436	11179	13735	0	3429
SA Pair	3913	29	366	467	1209	279	1042	295	226	0
Pair / Chan	7%	14%	8%	12%	6%	19%	9%	2%		0%
Sprint										
SA Chan	2916	149	557	573	508	475	530	123	0	0
SA Pair	1881	96	361	409	288	337	310	79	0	0
Pair / Chan	65%	64%	65%	71%	57%	71%	58%	64%		
U S West										
SA Chan	573138	370	21061	13246	46081	10869	80188	92028	74882	234412
SA Pair	170738	273	7696	4111	13780	3913	32349	28094	17372	63150
Pair / Chan	30%	64%	37%	31%	30%	36%	40%	31%	23%	27%

(i) For the Frontier results I moved the distribution investments generated in the 5000-10000 density zone from the pair run to the >10,000 density zone.

To check the impact of my methodology on cost and support I calculated cost and density zone support for U S West under the following scenarios.

First, I used the line count density zone distribution from the pair equivalent data base.

Second I used the line count density zone distribution from the pair equivalent data base for distribution and the channel equivalent database for feeder. The results are presented in the following table.

U S West *(i)*		
	Loop Cost	Support
Channel database base	$18.32	$50,437,888
Pair database base	$18.32	$42,594,978
Percentage Change	0%	-15.5%
Pair in Distribution / Channel in Feeder	$18.32	$45,312,076
Percentage Change	0%	-10.2%

(i) Given last minute minor corrections, the numbers in this table are not exact, but they do closely approximate the expected percentage changes.

Using the channel equivalent line counts as the basis for line count distribution between density zones results a higher universal service fund calculation when calculated by density zone.

The methodology can be made more precise when the area over which support is to be calculated is determined.